

that might be on the roots. Nothing could be detected, and we were strengthened in an opinion that they were true seedling canes by the very great difference in their mode of growth from that of canes growing from the eyes of canes. A few months later we found that there were several distinct varieties amongst them. In December 1888 we examined them with great care, and grouped them into ten groups according to their most strongly marked characteristics, and found that in many of our groups thus formed the canes graduated from one group into another. Many of these canes exhibited some of the characteristics of certain of our varieties, together with the characteristics of other varieties, but in some cases we could not even form any opinion as to their parentage, as they differed completely from any canes we had ever seen. During the latter stages of their growth these canes were examined by many planters and sugar chemists, all of whom were particularly struck with the amount of variation they exhibited and with the fact that certain of them were entirely different from any canes they had previously seen. The canes, as grouped, were replanted in the usual manner, and are now in course of experimental cultivation. The remaining canes were reaped on March 8, 1889, and fifty plants yielded 307 pounds of cane tops and 1626 pounds of canes, which gave 61 per cent. of juice of a density of 10°·6 Beaumé, containing 1·629 pounds of sucrose and 0·090 pounds of glucose in the imperial gallon. The following are the compositions of the canes, cane-juice, and megass:—

	Canes.	Cane-juice.	Megass.
Water	68·11	81·18	48·20
Sucrose	12·62	15·13	8·70
Glucose	0·69	0·83	0·48
Ash	0·47	0·30	0·75
Albuminoids	0·33	0·17	0·59
Fibre	15·44	—	39·60
Organic matters	2·34	2·39	1·68
	100·00	100·00	100·00

"In order to definitely settle the question of whether the sugar-cane produced fertile seed, from the middle of December 1888 to that of February 1889 most careful search was made through the fields for growing seedlings and for arrows containing fertile seed. The search for both of these proved successful, but only on the fields in which the varieties were growing and on which, as pointed out by us in our 1888 Report, the conditions for fertilization are most favourable. The seedlings, as found, were transplanted into boxes, but, on account of the unfavourable climatic conditions, great difficulty was experienced in preserving them: on one occasion an accidental exposure to the sun for about three hours destroyed five out of seven contained in the exposed box. One seedling was found attached to a portion of cane arrow which had fallen in a damp and sheltered position. The portions of cane arrows found which apparently contained fertile seed were collected, the apparent seeds carefully separated from the spikelets of the panicles and sown at intervals, commencing on January 12. Ten days after, some of the seeds were seen to be germinating, and certain of them were removed and preserved as microscopic objects. Of the apparent seeds, less than 5 per cent. germinated, and not more than one-fourth of the germinated ones finally survived.

"As the self-sown seedlings and those raised from the seeds by ourselves reached a sufficiently advanced stage of growth (the exceedingly slow growth of the seedlings at an early time is most marked, a point which in certain previous researches may have prevented the attainment of complete proof of the fact that the sugar-cane produces fertile seed, and in which mode of growth the seedlings strikingly differ from the rapid growth of canes from the buds) were, similarly to the seedlings of 1888, transplanted into the field, and are now in course of experimental cultivation.

"As far as our experience at present shows, the conditions most favourable for the production of fertile seed by the sugar-cane are found in the cultivation of varieties side by side and in comparatively large numbers, although from observations recently made, apparently fertilized ovules are to be found from time to time upon arrows of Bourbon canes growing by themselves. To secure the germination of the seeds, it is necessary to sow them soon after the arrow ripens, under similar conditions to those necessary with the seeds of other of the Gramineæ of low germinating power.

"The fertile seeds inclosed in the glumes are long and narrow, being from 3 to 4 millimetres in length and 0·65 to 0·70 millimetres in breadth, and terminate in a beard from 6 to 8 millimetres long."

MUSICAL SCIENCE.¹

THE object of this little pamphlet is one with which musical students are tolerably familiar. The author complains that the science of acoustics, although now well advanced, is unable to explain the actual structure of musical compositions, or to account for their effect on the mind. Many writers have made the same complaint, and have endeavoured, each according to his own fancy, to "account for" everything by some particular system of his own.

Now, it happens that some quarter of a century ago a person named Helmholtz wrote a great book with the express object of explaining this difficulty. He showed, about as conclusively as anything can be shown, that, although physical science has furnished an intelligible basis on which the musical art is founded, it goes but a very little way in explaining practical musical composition, this being guided chiefly by the æsthetic instincts and the artistic feelings of the best composers, with which physical science can have very little to do.

One would have thought that such a doctrine would be hailed with satisfaction by musicians, as exalting and ennobling the share of art in the generation of high-class music. But, strange to say, it is the musicians who chiefly dispute it, and who would wish to substitute for the heaven-born gift the dry process of scientific deduction.

Our author is of this opinion. He tells us that if by science we are to understand a thorough rational understanding of any subject, musical science has not yet been discovered; it waits still its Columbus, or its Galileo, or its Cuvier.

This may be in a certain sense true, but the science wanted for the purpose is not *physical* science. We know already pretty well all that physical science can tell us about music; but there is a science much deeper—namely, that which would investigate the general effect produced by music on the mind, as depending on its composition and style. This is the *psychology* of music, an abstruse branch of æsthetics, and it is this that must tell us, if it can, how music has attained its present power over the feelings and the emotions of mankind. It is only lately that attention has been called to this by competent writers; what is popularly said or sung about it has seldom any serious meaning.

The idea promulgated in this pamphlet is that all the mysteries of the art may be explained on the principles of *rhythm*—not, as usually understood, having to do with time and measure and accent and so on, but in a more hidden application to the generation of sounds. The system is not completely elaborated, and it is not possible to do more here than give a very general notion of it. The first six chapters treat of rhythms in general; and the author gives a drawing of a machine for illustrating them. This consists of a series of "Savart" ratchet wheels, which, having different numbers of teeth, can give rise to various rhythmic combinations of their beats. He then deduces "laws" from the consideration of these, of which the following are some specimens:—

"When we listen to a series of isochronous blows, we perceive them at once in binary rhythm, and we therefore call this perception *spontaneous, natural, and instinctive*.

"We cannot perceive a series of isochronous blows in ternary rhythm, except with the concurrence of the will; hence we call this perception *voluntary*."

These are simple fundamental laws; the following are more complicated ones:—

"Whatever is the number of teeth of a wheel, and the velocity at which it revolves, there is always the spontaneous perception of the isochronous series in binary rhythm.

"If, to a series perceived in binary rhythm, we cause another to follow, which has with it any ratio whatever represented by r , this will be at once perceived in the same ratio r , which proves that the brain is endowed with the faculty of comparison.

"In any association whatever of two series of different rhythms, there is the production of a forced perception which compels the immediate perception of the two rhythms."

¹ "Musiconomia; Leggi Fondamentali della Scienza Musicale." By Dr. Primo Cratti, Professor of the History of Music in the Royal Conservatory of Parma. (Parma, 1890.)

In chapter iv. he explains a "physiological hypothesis," that the natural impression given by binary rhythm arises probably from the naturally symmetrical structure of the human body, and the binary action of its functions, such as breathing and the beating of the heart, whereas a ternary rhythmic motion seems something heterogeneous and unnatural. In chapter v. he discusses the effects of rhythms on our organism, simple or natural rhythms giving an agreeable impression, and unnatural or complicated rhythms giving one of a contrary description. Then follows a long chapter of formulæ and complicated arithmetical statements of rhythmical combinations of various kinds.

These remarks, on rhythms generally, occupy two-thirds of the pamphlet; the remaining third is intended to show how they may be applied to the nature and effects of musical sounds. Chapter vii. contains a description of the major musical scale as harmonically deduced by the aid of the monochord; and after that we begin to get a glimpse, though obscurely, of the nature of the general argument. The following extracts may give an idea of it:—

"The only sounds of the scale which are in binary rhythm are the first, 1 : 1, and the last, 1 : 2; and these are in fact the only ones which imply rest. The fifth, 2 : 3, is constituted by a ternary rhythm, and is, in fact, the sound of greatest motion which is contained in the scale. This most powerful motive action gives to this sound the greatest tendency towards the sounds of rest, authorizing it to fall directly on them, however distant from it.

"The ratio 4 : 5, which represents the major third, is constituted by a quinary rhythm—a rhythm of semi-motion which has such an action that while it makes us feel faintly the need to pass to the fundamental, it may almost supply it coming after the fifth."

Thus we arrive at the kernel of the theory, which appears to be that the effects of different combinations of rhythmical blows or noises are assumed to be applicable to the vibrations causing musical sounds, and to account for the effects of such sounds in an emotional point of view. It is something akin to the old Euler doctrine of the "simplicity of ratios," but it professes to be more comprehensive.

It is not carried out very far in this book, but the author promises that if he lives long enough, and has sufficient means, he will complete it in a larger treatise. Then, perhaps, we shall see how it will explain the construction of "Israel in Egypt," Haydn's Quartettes, and Beethoven's Ninth Symphony.

THE MUSEUMS ASSOCIATION.

THE first annual meeting of the Museums Association was held in Liverpool on June 17, 18, and 19, under the presidency of the Rev. H. H. Higgins, M.A. Liverpool was represented by the President, Mr. J. T. Moore, Mr. R. Paden, Mr. J. Chard, Mr. P. Cowell, Mr. H. A. Tobias, and a number of other gentlemen. In addition to the home contingent, the following were present:—Mr. F. W. Rudler, Mr. R. J. Howard, Mr. R. Ashton (Blackburn); Mr. J. Vicars, Mr. J. J. Ogle (Bootle); Mr. W. W. Midgley (Bolton); Mr. Butler Wood (Bradford); Mr. John Storrie (Cardiff); Mr. Montagu Browne (Leicester); Mr. C. G. Virgo (Manchester); Mr. T. J. George (Northampton); Mr. J. W. Carr (Nottingham); Mr. R. Howse (Newcastle); Prof. Boyd Dawkins, Mr. W. E. Hoyle (Owens College); Major Plant (Salford); Alderman Brittain, Mr. E. Howarth (Sheffield); Lieutenant-Colonel Turner, Mr. John Tym (Stockport); Mr. Robert Cameron, Mr. J. M. Bowley (Sunderland); Mr. L. Greening, Mr. H. Roberts, Mr. F. W. Moncks, Mr. C. Madeley (Warrington); Mr. H. M. Platnauer (York).

The proceedings were opened by Mr. J. T. Moore, as Mr. S. W. North, chairman at the last meeting (held in York), was unavoidably absent. The Rev. H. H. Higgins gave his presidential address, and the following papers were read and discussed:—"On Museum organization and arrangement," by Prof. W. Boyd Dawkins, F.R.S.; "Suggestions for aid in the determination of natural history specimens in Museums," by Mr. F. W. Rudler; "A new method of mounting Invertebrates for Museum and lecture purposes," by Dr. H. C. Sorby, F.R.S.; "Notes on the Liverpool Free Public Museum," by Mr. T. J. Moore; "Circulating school cabinets for elementary schools," by Mr. John Chard (Assistant in the Liverpool Museum); "The best means of making Museums attractive to

the public," by Mr. R. Cameron; "A plea for local geological models," by Mr. T. J. Moore; "Museum cases and Museum visitors," by Mr. E. Howarth; "Notes on the Moscow Museum," by Mr. Willoughby Gardner; "Winter evening lectures in Museums," by Mr. R. Paden (Assistant in the Liverpool Museum).

Some very pleasant expeditions were made, thanks to the untiring energy of the local Secretary, Mr. H. A. Tobias, who was ably seconded by Mr. Cowell and Mr. McMillan. The members of the Association were most hospitably received; they were entertained at lunch by his worship the Mayor, and received invitations to a *soirée* of the Library, Museum, and Arts Committee, and to a magnificent *conversazione* given by the Japanese Consul, Mr. James L. Bowes.

SCIENTIFIC SERIALS.

American Journal of Science, June.—Prof. Elias Loomis: a memorial address prepared by H. A. Newton at the request of the President and Fellows of Yale College.—The magnetic field in the Jefferson Physical Laboratory, Part II., by R. W. Willson. In the February number of the *Journal* the author gave some observations of the variations of the horizontal intensity in different parts of the Jefferson Physical Laboratory in 1886-87, and upon the disturbance in the magnetic field produced by the presence of iron steam pipes and other iron masses. He now finds from extended observations that brickwork produces a great disturbance of the magnetic field, and thinks, therefore, that in general it would be safer to make exclusive use of wood for buildings and piers intended for refined magnetic measurements.—The electrical resistance of the alloys of ferro-manganese and copper (from determinations made by Mr. B. H. Blood), by Edward L. Nichols. The observations show that ferro-manganese-copper alloys decrease in electrical resistance each time they are subjected to a change of temperature. In one case an alloy containing 80.82 per cent. of copper and 19.12 per cent. of ferro-manganese, was hard drawn in the process of obtaining a strip suitable for measurement. Its specific resistance at 20°, referred to pure copper as unity, was 30.38; this resistance gradually diminished as the strip was repeatedly heated to 100° and cooled to 20°, until after seven such heatings it had fallen to 30.072. The effect of successive annealings upon the resistance of a number of alloys is also described.

—Fluid volume and its relation to pressure and temperature, by C. Barus. The paper contains the introductory part of a series of experiments on the compressibility of liquids, in progress at the Physical Laboratory of the U.S. Geological Survey. Taking the results from 0° to 185° as a whole, it follows that if with the observed thermal expansion compressibility be supposed to increase inversely as the first power of the *pressure binomial* ($A + p$, where A is constant), then temperature and pressure must vary linearly to maintain constancy of volume.—On hamlinite, a new rhombohedral mineral from the herderite locality at Stoneham, Mi., by W. F. Hidden and S. L. Penfield.—On a large spring-balance electrometer for measuring (before an audience) specific inductive capacities and potentials, by Alfred M. Mayer. The chief characteristic of the excellent piece of apparatus described is that it shows *directly*, and not inferentially, that different dielectrics transmit the force of electricity in different degrees.—Notice of new Tertiary mammals, by O. C. Marsh.

THE *American Meteorological Journal* for June contains:—An article on the distribution of cloud over the globe, specially prepared by M. L. Teisserenc de Bort from a former paper on this subject (*NATURE*, vol. xxxvi. p. 15), with diagrams of mean isonephs for March, which is the clearest month over the globe, and for July, which, on the whole, is a cloudy month, and also with figures showing the appearance of the cloud bands on the earth, compared with other planets having atmospheres.—Is the diurnal variation of the magnetic needle a meteorological phenomenon?, by Prof. R. Owen. The object of the paper is to show that our atmosphere is the medium influenced magnetically by the sun, in affecting the diurnal movement of the needle. The author thinks that the facts adduced may aid us in understanding why storms in the northern hemisphere rotate from right to left, and advance from lower to higher latitudes.—A translation of Dr. R. Assmann's paper on the climatological influence of influenza.—Report of the meeting of the New Eng-